CLAIMS

I CLAIM:

1. A method for enhancing the application of UV light to UV photo initiators in a UV curable product, article, ink, coating, adhesive or other object, comprising the steps of:

positioning a plurality of UV LED assemblies that emit light at wavelengths between 180 and 420 nm in a row on a panel;

arranging the UV LED assemblies in the row so that adjacent UV LED assemblies emit UV light at different wavelengths; and,

moving the panel relative to a UV curable product to distribute the UV light at different wavelengths across the UV curable product.

2. The method of claim 1 wherein the UV LED assemblies emit UV light at wavelengths between 315 and 400 nm.

3. The method of claim 1 wherein some of the UV LED assemblies emit UV light at a peak wavelength of 365 nm and other of the UV LED assemblies emit UV light at a peak wavelength of 385 nm.

4.. The method of claim 1 including the step of injecting an inert gas in a space between the panel and the UV curable product.

5.. The method of claim 1 including the step of placing one of a plastic or glass sheet or plate between the UV LED assemblies and the UV curable product.

6. The method of claim 1 including the step of providing at least one row of UV LED assemblies that emit light in the visible light spectrum whereby a user can visually determine that power is being supplied to the UV LED assemblies.

7. The method of claim 1 including the step cooling the UV LED assemblies to keep the temperature of the UV-LED chips within a predetermined range.

8. The method of claim 7 wherein the step of cooling is achieved, at least in part, by mounting the UV LED assemblies on a heat sink.

9. The method of claim 8 including the step of providing the heat sink with heat dissipating fins.

10. The method of claim 10 wherein the step of cooling is achieved, at least in part, by blowing a cooling fluid over the heat dissipating fins.

11. The method of claim 1 including the step of placing the UV LED assemblies at a distance from the UV curable product which will provide a substantially uniform pattern of light diverging from the UV-LED assemblies of at least 50% of the power output from the UV-LED assemblies according to a viewing cone angle of $2\theta_{1/2}$.

12. The method of claim 1 including the step of providing UV LED chips which comprise large junction UV-LED chips (over 400 microns on a side) in the UV LED assemblies for emitting UV light at a higher light density.

13. The method of claim 1 including the step of selecting UV LED chips for the UV LED assemblies wherein the current drawn by the chips only varies between about 5% and about 10%, thereby to minimize "current hogging" by the UV LED chips in the UV LED assemblies.

14. The method of claim 1 including the step of providing ink, coating or adhesive having photo initiators that are activated by light at more than one wavelength.

15. The method of claim 14 wherein some of the photo initiators are activated by light that is peak at approximately 365 nm and other photo initiators are activated by light that is peak at approximately 385 nm.

16. An apparatus for enhancing the application of UV light to UV photo initiators in a UV curable product, article, ink, coating, adhesive or other object, comprising:

a plurality of UV LED assemblies that emit light at wavelengths between 180 nm and 420 nm arranged in a row on a panel;

the UV LED assemblies in the row being arranged so that adjacent UV LED assemblies emit UV light at different wavelengths; and,

a panel moving device for moving the panel relative to a UV curable product to distribute the UV light at different wavelengths across the UV curable product.

17. The apparatus of claim 16 wherein the UV LED assemblies emit UV light at wavelengths between 315 and 400 nm.

18. The apparatus of claim 16 wherein some of the UV LED assemblies emit UV light at a peak wavelength of 365 nm and other of the UV LED assemblies emit UV light at a peak wavelength of 385 nm.

19. The apparatus of claim 16 wherein an inert gas is placed in a space between the panel and the UV curable product.

20. The apparatus of claim 16 wherein a protective plastic or glass sheet or plate is placed between the UV LED assemblies and the UV curable product.

21. The apparatus of claim 16 including at least one row of UV LED assemblies that emit light in the visible light spectrum whereby a user can visually determine that power is being supplied to the UV LED assemblies.

22. The apparatus of claim 16 including means for cooling the UV LED assemblies to keep the temperature of the UV-LED chips within a predetermined range.

23. The apparatus of claim 22 wherein the means for cooling include, at least in part, the mounting of the UV LED assemblies on a heat sink.

24. The apparatus of claim 23 wherein the heat sink has heat dissipating fins.

25. The apparatus of claim 24 wherein the cooling means include propelling means comprising at least one fan for blowing a cooling fluid over the heat dissipating fins.

26. The apparatus of claim 16 wherein the UV LED assemblies are located at a distance from the UV curable product which will provide a substantially uniform pattern of light diverging from the UV-LED assemblies of at least 50% of the power output from the UV-LED assemblies according to a viewing cone angle of $2\theta_{1/2}$.

27. The apparatus of claim 16 wherein the UV LED chips in the UV assemblies are large junction UV-LED chips (over 400 microns on a side) for emitting UV light at a higher light density.

28. The apparatus of claim 16 wherein the UV LED chips for the UV LED assemblies have a current drain which only varies between 5 and 10%, thereby to minimize "current hogging" by the UV LED chips in the UV LED assemblies.

29. The apparatus of claim 16 combined with an ink, coating or adhesive having photo initiators that are activated by light at more than one wavelength.

30. The apparatus of claim 29 wherein some of the photo initiators are activated by light that is peak at approximately 365 nm and other photo initiators are activated by light that is peak at approximately 385 nm.

31. A method for enhancing the application of UV light to UV photo initiators in a UV curable product, article, ink, coating, adhesive or other object, comprising the steps of:

positioning a plurality of UV LED chips on a substrate;

mounting a heat sink on the substrate;

positioning a variable speed fan adjacent the heat sink;

causing relative movement between the substrate and a UV curable product, article, ink, coating, adhesive or other object to illuminate the UV curable product, article, ink, coating, adhesive or other object with UV light to cure the product, article, ink, coating, adhesive or other object;

sensing one of light intensity from the UV-LED chips or temperature of the heat sink; and,

controlling the temperature of the heat sink to control the light intensity from thre UV-LED chips by controlling the cooling air blown by the fan toward the heat sink by controlling the speed of the fan in response to one of the light intensity.sensed or the temperature of the heat sink sensed, thereby to maintain the UV-LED chips at a generally constant temperature which results in a generally constant light output from the UV-LED chips.

32. An apparatus for enhancing the application of UV light to UV photo initiators in a UV curable product, article, ink, coating, adhesive or other object, comprising:

a plurality of UV LED chips mounted on a substrate;

a heat sink mounted on said substrate;

a variable speed fan mounted adjacent said heat sink;

a moving mechanism for causing relative movement between said substrate and the UV curable product, article, ink, coating, adhesive or other object to illuminate the UV curable product, article, ink, coating, adhesive or other object with UV light to cure the UV curable product, article, ink, coating, adhesive or other object;

a light sensor positioned to sense light from said UV-LED chips,

a control circuit coupled to said light sensor and to said fan for controlling the temperature of said heat sink to control the light intensity from said UV-LED chips by regulating the cooling air blown by said fan toward said heat sink by varying or adjusting the speed of said fan in response to the light intensity sensed.

33. An apparatus for enhancing the application of UV light to UV photo initiators in a UV curable product, article, ink, coating, adhesive or other object, comprising:

a plurality of UV LED chips mounted on a substrate;

a heat sink mounted on said substrate;

a variable speed fan mounted adjacent said heat sink;

a moving mechanism for causing relative movement between said substrate and the UV curable product, article, ink, coating, adhesive or other object to illuminate the UV curable product, article, ink, coating, adhesive or other object with UV light to cure the UV curable product, article, ink, coating, adhesive or other object;

a temperature sensor mounted on said heat sink;

a control circuit coupled to said temperature sensor and to said fan for controlling the temperature of said heat sink to control the light intensity from said UV-LED chips by regulating the cooling air blown by said fan toward said heat sink by varying or adjusting the speed of said fan in response to the temperature sensed.

34. A UV light emitting system comprising a plurality of UV-LED chips for emitting UV light and a controller operatively associated with said UV-LED chips for maintaining the intensity of the UV light emitted generally constant.

35. A printing and curing station for printing a UV curable ink on a product, article, or other object and for applying UV light to UV photo initiators in the UV curable ink on the product, article, or other object, comprising:

a printing station;

a support

a first moving mechanism for moving the printed product, article, or other object onto said support;

an assembly of UV-LED arrays containing a plurality of UV-LED chips mounted over the support;

and a second moving mechanism for causing relative movement between the assembly of UV-LED arrays and the support.

36. The printing and curing station of claim 35 wherein: the first and second moving mechanisms are one moving mechanism.

37. The printing and curing station of claim 36 wherein:

said support is a turntable for carrying products beneath spaced apart printing heads and spaced apart UV-LED assemblies; and,

said one moving mechanism rotates or indexes said turntable.

38. The printing and curing station of claim 35 wherein:

said second moving mechanism is a conveyor which also defines said support and said conveyor is constructed and arranged to move products under said UV-LED assembly.

39. The printing and curing station of claim 35 wherein said second moving mechanism is constructed and arranged to reciprocate said UV-LED assembly over products on said support which is stationary.